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Abedeto – a tool to constrain event depth by depth phase modelling and visualization

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Hypocenter depths yield important information which can help to discriminate between induced and natural seismicity. While epicentral locations of earthquakes can usually be infered reliably, depth estimates generally have larger uncertainties, often linked to the trade-off with origin time.
A common approach addressing depth estimate uncertainties is to investigate travel time differences of direct and surface reflected arrivals, which are sensitive to source depths. Unfortunately, identification and picking of depth phases is error prone.
We present a tool named Abedeto ('Array Beam Depth Tool') for teleseismic depth phases analysis based on waveform modelling. We thereby circumvent the problem of phase identification. It automatically queries data centers for array waveforms and stacks the retrieved data based on theoretical backazimuth and slownesses. This allows to analyse events with low magnitudes as it is usually the case for induced seismicity.
Waveform modelling is done based on separated velocity models at the source and receiver site. By aligning synthetic and recorded waveforms in a time frame covering direct and surface reflected phases the depth can be inferred by visual comparison.
We demonstrate the toolbox by means of recent shallow induced seismic events. Among others, these are events which ocurred in Colombia, Oklahoma (USA), and close to the Castor gas injection project, offshore Spain.